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Stem Data Management System for the Great Lakes Stem Profile Modelling Project Version 2.0

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Abstract

This note describes the current status of and provides background documentation for the Stem Data Management System (SDMS) developed in support of the Great Lakes Stem Profile Modelling Project (GLSPMP). GLSPMP was established to define Zakrzewski's (1999, 2004) stem profile model for major commercial tree species in the Great Lakes region. For this exercise a relevant regional database containing stem profile measurements was needed. The ultimate objective of GLSPMP is to improve local timber product estimates and to enable cross-border comparisons of harvest and productivity potential of forest sites within the region of interest. GLSMP was established by the Ontario Ministry of Natural Resources[1] (OMNR) Ontario Forest Research Institute (OFRI), in partnership with Michigan, Minnesota, and Wisconsin Departments of Natural Resources, the USDA Forest Service, and with the support of Michigan State University. SDMS V. 2.0, which is designed to facilitate the collation, management, and analysis of stem analysis data, contains measurements from almost 23,000 trees. The system allows the integration of data from a variety of sources and formats into a single, unified database that is easy to use, primarily for stem profile modelling. The intent is for SDMS to be expanded over time. The measurements and computer programs used to process the data, as well as final output (in MS Access and CSV, comma delimited file, formats) are available on request.

Résumé

Ce document décrit l'état actuel du système de gestion des données sur les tiges (SGDT) et fournit des renseignements de base sur ce système, qui a été mis au point dans le cadre du projet de modélisation du défilement des peuplements des Grands Lacs (PMDPGL). Ce projet a été mis en oeuvre pour définir le modèle de défilement de Zakrzewski (1999, 2004) applicable aux principales essences commerciales de la région des Grands Lacs. Pour cet exercice, on avait besoin d'une base de données régionales pertinentes sur le défilement. Le PMDPGL a pour but ultime d'améliorer les estimations du volume de bois des peuplements locaux et d'effectuer des comparaisons transfrontalières de la récolte et de la productivité potentielles de forêts dans une région donnée. Ce projet a été mis en oeuvre par le ministère des Richesses naturelles de l'Ontario (MRNO) et l'Institut de recherche forestière de l'Ontario (IRFO) en collaboration avec les ministères des richesses naturelles du Michigan, du Minnesota et du Wisconsin et le USDA Forest Service, et avec l'appui de l'université du Michigan. Le SGDT version 2.0, qui a pour but de faciliter la collecte, la gestion et l'analyse de données sur les tiges, contient les données de près de 23 000 arbres. Il permet de réunir des données de divers formats et sources dans une base de données unique que l'on peut facilement utiliser, surtout pour produire des modèles de défilement. On entend étoffer le SGDT avec le temps. On peut obtenir sur demande les données, les programmes informatiques utilisés pour les traiter et le produit final complet (en fichier CSV et MS-Access).

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Introduction

The Stem Data Management System (SDMS) has been developed in support of the Great Lakes Stem Profile Modelling Project (GLSPMP), which was established by the Ontario Ministry of Natural Resources' (OMNR) Ontario Forest Research Institute (OFRI), in partnership with Michigan, Minnesota, and Wisconsin Departments of Natural Resources (DNRs), the USDA Forest Service, and the support of Michigan State University, to improve local timber product estimates and to enable cross-border comparisons of productivity potential of forest sites within the region of interest. Specifically, GLSPMP was initiated by B. Kissick from OMNR, Forest Business and Economics Section, and W.T. Zakrzewski from OFRI to address the need for wood measurement modelling tools and procedures to support the softwood lumber legal dispute between the U.S. and Canada. The main goal of GLSPMP was to define Zakrzewski's (1999, 2004) stem profile model for major commercial tree species of the Great Lakes region's jurisdictions (Ontario, Canada, and the respective U.S. states). Related modelling tasks required a relevant regional database, precipitating the development of SDMS.

The geographic area of interest for the modelling project belongs to two major ecological regions: Northern Forests and Eastern Temperate Forests (Ecological Regions of North America 1997). The Northern Forests stretch through the northern part of the Great Lakes region, covering northern Ontario, northern Michigan, and Minnesota. This region is associated with hilly terrain on the Canadian Shield's bedrock. The landscape is dotted with numerous lakes. The climate is characterized by the long cold winters and short summers. Forests are dominated by coniferous species. The Eastern Temperate Forests cover the southern part of the area of interest to the GLSPMP. A variety of geological forms and landscapes are present. The region is distinguished by a climate milder and more humid than the Northern Region, diverse forest cover, and high density of human population. Forests consist of both deciduous and coniferous species, often dominated by broadleaf trees.

This report describes the current status of the Stem Data Management System (SDMS V. 2.0), including its structure, content, and protocols for use.

Stem Data Management System (SDMS)

SDMS was developed to facilitate the collation, management, and processing of stem analysis data. It is designed to allow data from a variety of sources and formats to be integrated into a single, unified database, primarily for use in stem profile modelling.

SDMS consists of a database that houses the data in a consistent format (regardless of its source) and software modules that are used to process the data. Processing tasks (Figure 1) include:

- translating data from external structures, standards, and formats to that used in the database
- validating data to check for errors and identify problem records
- importing validated data into the database
- exporting subsets of the data from the database for analysis

Data are processed and the database is structured using the statistical package SAS 9.1 (SAS Institute, Inc. 2005). SAS was chosen because the software includes procedures for accessing and managing data sets of variable origin and format as well as the capability to export data in formats desired by the users. Sophisticated statistical procedures for model calibration are also readily available within the SAS framework.

The data sets and structure of SDMS V. 2.0 will be expanded to accomodate new data and methodologies. For example, the current structure of SDMS will need to be updated to reflect new stem measurement technologies, such as digital scanning of tree disks, now being applied in Ontario.

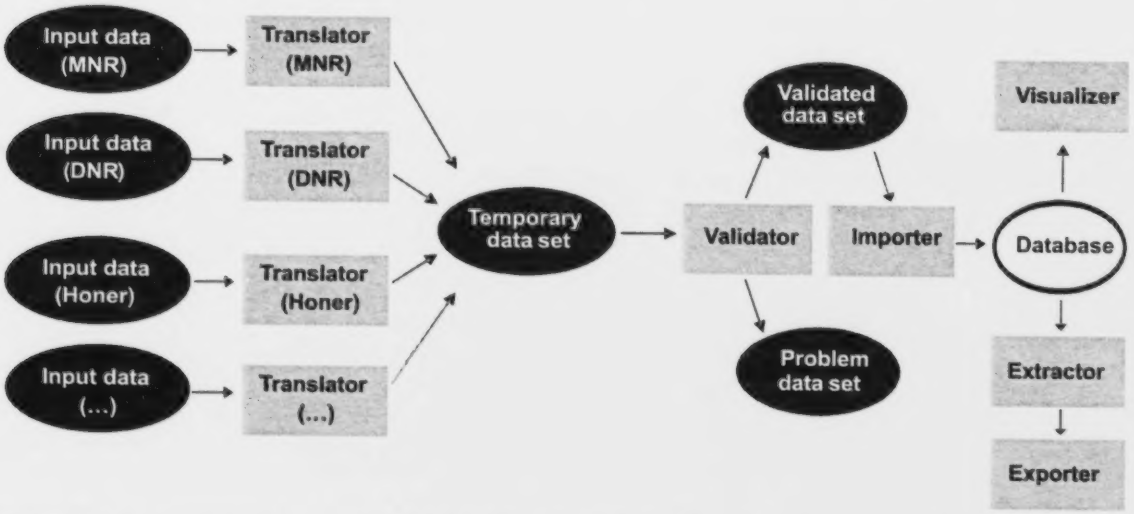

Figure 1. *Data processing modules and related data sets within the Stem Data Management System V. 2.0.*

Database

The SDMS v. 2.0 consists of seven tables: Source, Site, Tree, Section, Ring, Branch, and Piece defined as follows:

- Source — Contains data pertaining to the source responsible for a data set. This may refer to an organization (e.g., OMNR), an individual, or other data source.
- Site — Contains data pertaining to a set of related trees. May refer to a plot, stand, or any other logical grouping of trees.
- Tree — Contains individual, whole tree data.
- Section — Contains data pertaining to individual stem sections.
- Ring — Contains ring width measurements.
- Branch — Contains data pertaining to branches that come off stem sections or other branches. Diameter measures on branches pertain to the base of the branch.
- Piece — Contains data pertaining to pieces of branches. Diameter measures on pieces pertain to the top of the piece (distinguishing these measurements from the base of the associated branch).

The tables are linked in a relational database structure, in a series of one-to-many relationships as follows: for each source, there may be one or more sites; for each site, there may be one or more trees; for each tree, there may be one or more sections.

Tables are linked by appropriate key fields. For example, each record in the Section table has a TreeID field, linking that section to a unique tree in the Tree table. Each record in the Tree table has a SiteID field, linking that tree to a unique set of trees (e.g., plot or stand) in the Site table.

The relational nature of the database makes it possible to extract subsets of records using Structured Query Language (SQL) statements. The structure of the database is illustrated in Figure 2. Fields are described in more detail in Appendix I.

Data Processing Modules

The SDMS includes the following data processing modules:

- Translator — Translates data from an external data source into a format compatible with the database system, creating a Temporary data set.
- Validator — Validates translated data, i.e., generates one data set with all the records indexed with the error codes (Validated data set), where good records have the error code equal to zero, and the other containing problem records (Problem data set), with error codes different from zero.

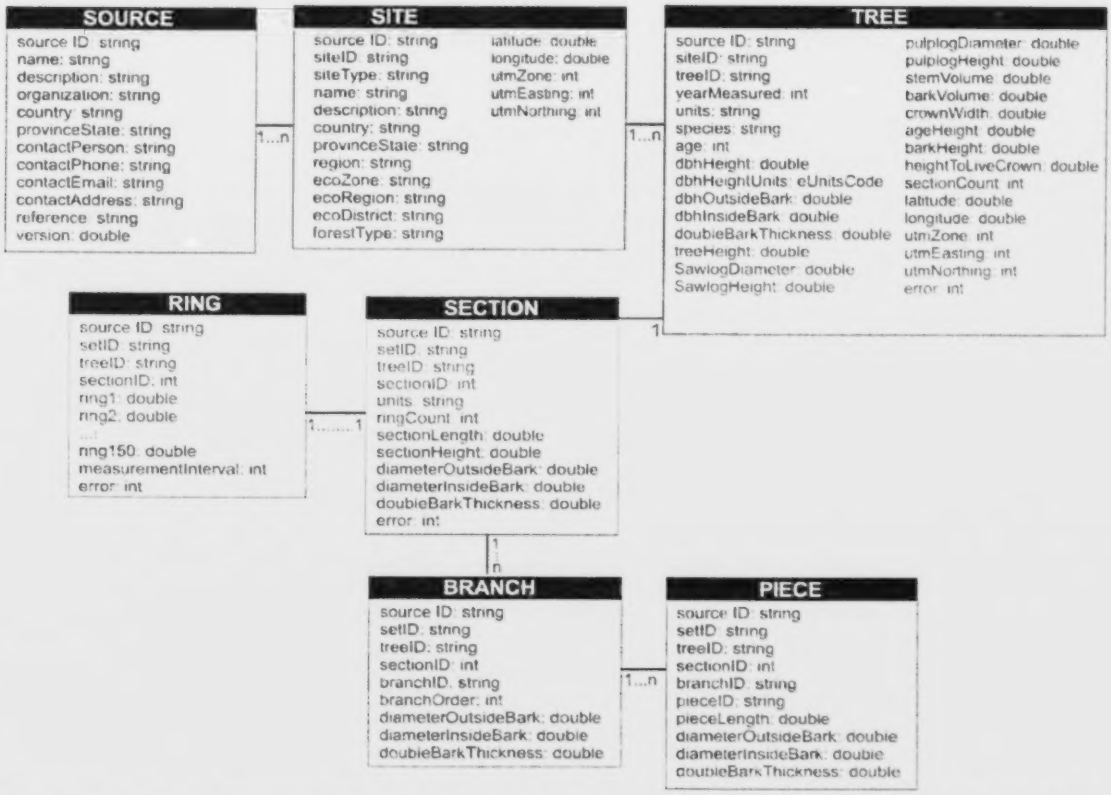

Figure 2. Structure of the subcomponents of the Stem Database Management System. (Codes are defined in Appendix 1.)

- Importer — Imports translated and validated data from the Validated data set into the database.
- Extractor — Extracts subsets of the data from the database system as required to generate temporary data sets for modelling and analysis. Places tables in the Extract library.
- Exporter — Exports the tables that are in the Extract library, converting them to CSV format and placing them in the Export folder.
- Visualizer — Generates maps and images of the geographical location of stands, plots, and/or individual trees (not completed, in progress)

The modules and their relation to the data sets and final database are illustrated in Figure 1.

A translator was developed for each unique source format of input data (e.g., Beckwith, Honer, Hansen). All translators yield the same output format. Each Translator extracts the subset of records and fields from the source as required to match the output database. Translation may include code conversion, for example, converting species codes from the source standard to the database standard.

The Validator checks for a suite of potential errors and inconsistencies in the data. For example, a negative height measurement would be considered an error, as would an inside bark diameter measurement that is greater than an outside bark diameter measurement on the same section.

Implementation of SDMS

The database is implemented in SAS and comprises the tables identified above, stored as SAS data sets. The tables are indexed on fields that are commonly used for sorting to maximize query performance.

Modules are written in the SAS programming language, making use of the SAS Data Step procedure, SAS macros, and SAS SQL, as required. A separate SAS program was developed for each module (i.e., Validator, Importer, Extractor, Exporter). As well, a separate program was developed for each Translator.

Pre-programmed SQL statements may be used to query the database and generate summary tables and reports. SQL also may be used to extract specific sub-sets of the data for subsequent processing and modelling work.

Export and import capabilities within SDMS allow the exchange of data to and from common database formats, such as Microsoft Access and CSV.

Stem Analysis Data in SDMS

Eight data sets are included in the SDMS V. 2.0 database. Data sets names refer to the originator of the data collection project (e.g., Dr. Terry Honer) or the jurisdiction from which sample trees were taken (e.g., Kimberly-Clark, private company). They are described briefly below. A tabular summary (Table 1) follows the description of the data sets. Notice that the summary table was created using "raw" data, and that the data sets may cover geographic regions wider than those of current interest to the GLSPMP. SDMS V. 2.0 uses a validator module (SAS program) to help to identify, but not remove, the errors. Data users (and the data's owners) are responsible for "cleaning" the data. This may involve comparing the original records (paper tallies) with those in the database or interpolations.

Beckwith data set. Includes stem analysis data from more than 1300 trees from thinned stands from various permanent sample plot installations established by the Ontario Tree Improvement and Forest Biomass Institute (now OFRI). In the early years, stem diameter information was gathered by sectioning the felled trees into 4 and 8 foot lengths (about 122 and 244 cm, respectively). A ruler was used to measure (in two directions) the inside bark diameter for the bottom of each section. In the early 1980s, as computer-aided stem analysis applications were being developed, a "Digimic" system along with the Tree Ring Increment Measurement (TRIM) system was used to measure ring widths (and ultimately diameter) for multiple cookies sectioned from trees.

Boise Cascade data set. Includes detailed diameter and height increment for 98 jack pine trees from permanent sample plots (PSPs) established by Boise-Cascade Ltd. in jack pine-dominated stands. These PSPs were located in the Kenora and Fort Frances area (boreal forests of northwestern Ontario). Five trees per plot, representing one tree from each of five size classes present on the plot, were felled and sectioned. TRIM System was used to assess diameter and height increment for each tree section. The data set is documented by Miller and Woods (1991).

Hansen data set. Includes over 9600 trees measured on 590 commercial logging operations in 5 states (Illinois, Minnesota, Missouri, Wisconsin, and Michigan), involving 62 different species, and forms part of the North Central FIA utilization data set. Sampling occurred over a 15-year period (1981 to 1996) to assess the utilization of harvested timber in the North Central Region. A cross-section of trees harvested for both pulpwood and saw timber were selected from cooperating loggers on both public and private lands. Copies of the procedures used to select and measure individual trees can be requested from Mark Hansen, (see Appendix V for contact information). Related studies are documented in Smith (1991) and Blyth and Smith (1979).

Honer data set. Includes over 9300 trees, mainly softwoods, from natural stands across Canada. A subset of Ontario data consists of

measurements from 3350 trees. Data collection was initiated in 1964 by T.G. Honer at the Forest Management Institute in Ottawa, Ontario, and resulted in The Forest Management Institute's Tree Data Bank. The original data set, sampled across Canada, is documented in detail by MacLeod (1978).

Kimberly-Clark data set. Includes stem analysis data for 120 jack pine trees from measurements of PSPs established in the 1950s by Kimberly Clark Ltd. in jack pine-dominated stands; PSPs were located in the Longlac-Geraldton area (boreal forests of northwestern Ontario). Five dominant trees per plot, representing one tree from each of top five diameter classes present on the plot, were felled and sectioned for stem analysis. Representative trees were selected beyond the plot boundary. A TRIM System was used to measure diameter increment (ring measurements) for each tree section. The data set is documented by Miller and Woods (1991).

MacFarlane data set. Includes stem analysis data for over 800 trees. The data collection project was initiated and completed in 2004; the objective was to validate current Michigan DNR volume equations as well as to support the Great Lakes Stem Profile Modelling Project by developing new models for Michigan. Data was collected at 19 sites: 6 in the Upper Peninsula of Michigan and 13 in the Lower Peninsula. Study locations covered a broad range of stand types, harvest types, and geographic locations on Michigan DNR timberlands (and some private lands). Where possible, equal numbers of trees in each of five DBH size classes: 4.6-9.5", 9.6-13.5", 13.6-19.5", 19.6-24.5", and over 25" (11.5-24, 24.5-34, 34.5-50, 50.5-62, and over 62.5 cm, respectively). Sections of main stem and branches were measured, and the branch structure of each tree was diagrammed. Stump height and the length of each stem section and diameter inside and outside bark, measured in two perpendicular directions, were recorded.Trees with excessive defect, with unusual form, or with dead or missing tops were excluded from sampling. A full description of the data (including a list of tree species) is provided in MacFarlane (2005).

Northeastern Region (NER) data set. Includes detailed diameter and height increment for 174 older jack pine trees. The stem analysis data in this data set supported the investigation of longevity of older jack pine trees. Temporary sample plots were established north of Massey, Ontario (transitional-boreal forests of northeastern Ontario). In addition, five trees per plot were felled and sectioned for stem analysis. These trees represented one tree from each of five size classes present on the plot. Measurements involved using a TRIM System to define diameter (ring measurements) and height increment for each tree section. The data set is documented by Miller and Woods (1991).

Van Dyck data set. Includes data for over 1200 trees. Data collection, led by M. Van Dyck, was initiated in 2001 by USDA Forest Service (Eastern Region and the Forest Management Service Centre) and is on-going. The ultimate objective of the project is to replace the existing volume estimation procedures with a system based on a taper model. Samples were taken from National Forest areas in the Great Lakes states (Minnesota, Michigan, Wisconsin), and many other states of the Eastern Region. Sampling was conducted to measure trees from a cross-section of species and sizes from a range of site conditions. Trees with severe damage or deformities were not sampled.

Using data contained in SDMS is possible and encouraged, as long as the data sharing policies, specified in Appendix V, of the organizations that contributed data sets are respected.

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Appendix I:

Description of Database Tables Included in the Stem Data Management System

Source Table

Field Name	Data Type	Required	Description
sourceID*	string	yes	unique ID of the source
name	string		brief name of data source
description	string		description of data source
organization	string		organization associated with the data source
country	string		location of data source (country)
provinceState	string		location of data source (province)
contactPerson	string		person responsible for data source
contactPhone	string		phone number of contact person
contactEmail	string		email address of contact person
contactAddress	string		postal address of contact person
reference	string		related literature reference to the data
version	double	yes	version of the database (assigned by system)

*key field

Site Table

Field Name	Data Type	Required	Description	Units
sourceID*	string	yes	ID of the parent source (link to Source Table)	
siteID*	string	yes	ID of the parent site	
siteType	string	yes	type of site: e.g., plot, stand, unit	
name	string		name of site	
description	string		site description	
country	string		country in which site is located	
provinceState	string		province or state in which site is located	
region	string		geographic region in which site is located	
ecoZone	string		eco-zone in which site is located	
ecoRegion	string		eco-region in which site is located	
ecoDistrict	string		eco-district in which site is located	
forestType	string		forest cover on the site at time of data collection	
latitude	double		latitude of site	decimal degrees
longitude	double		longitude of site	decimal degrees
utmZone	int		UTM zone of the site	
utmEasting	int		UTM easting for the site	m
utmNorthing	int		UTM northing for the site	m

Tree Table

Field Name	Data Type	Required	Description	Units	Notes
sourceID*	string	yes	ID of parent source (link to Source Table)		
siteID*	string	yes	ID of parent site (link to Site Table)		
treeID*	string	yes	ID of tree		
country	string		country in which tree is located		
provinceState	string		province/state in which tree is located		
yearMeasured	int		year tree was measured		
units	string	yes	type of unit: metric or imperial		1
species	string	yes	species code		
age	integer		tree age	years	
dbhHeight	double		height at which dbh is measured	m or ft	
dbhHeightUnits	string		units in which dbhHeight is measured		2
dbhOutsideBark	double		dbh outside bark	cm or in	
dbhInsideBark	double		dbh inside bark	cm or in	
doubleBarkThickness	double		double bark thickness at dbh height	mm or in	
treeHeight	double		total tree height	m or ft	
pulplogDiameter	double		diameter of pulp log	cm or in	
pulplogHeight	double		stem height of pulplog diameter	m or ft	
sawlogDiameter	double		diameter of sawlog	cm or in	
sawlogHeight	double		stem height of sawlog diameter	m or ft	
stemVolume	double		total stem volume estimate	m^3 or ft^3	
barkVolume	double		bark volume estimate	m^3 or ft^3	
crownWidth	double		width of crown	m	
ageHeight	double		height at which age is taken	cm or in	
barkHeight	double		height at which bark is measured	cm or in	
heightToLiveCrown	double		height to live crown	m or ft	
sectionCount	integer		number of sections in the stem		
latitude	double		latitude of tree	dec degrees	
longitude	double		longitude of tree	dec degrees	
utmZone	int		UTM zone of the tree		
utmEasting	int		UTM easting of the tree	m	
utmNorthing	int		UTM northing of the tree	m	
error	int		error code for the tree	integer code	

Notes:

1. 'm' for metric, 'i' for imperial.

2. needed because in at least one case (the Honer data set), the unit of measure for dbhHeight may not be the same as specified in units (in the Honer data set, units of measure for data in general are metric, but the height of dbh is specified in metres for some trees, feet for others) - 'm' for metric, 'i' for imperial.

Section Table

Field Name	Data Type	Required	Description	Units	Notes
sourceID*	string	yes	ID of the parent source (link to Source Table)		
siteID*	string	yes	ID of the parent site (link to Site Table)		
treeID*	string	yes	ID of the parent tree (link to Tree Table)		
sectionID*	string	yes	ID of the section		
units	string	yes	type of unit: metric or imperial		1
ring count	int		age at height of measurement	years	
sectionLength	double		length of the section	m or ft	
sectionHeight	double		height of section (at bottom)	m or ft	2
diameterOutsideBark	double		diameter outside bark at height of measure	cm or in	
diameterInsideBark	double		diameter inside bark at height of measure	cm or in	
doubleBarkThickness	double		double bark thickness at height of measure	mm or in	
error	int		error code for the section	integer code	

Notes:

1. 'm' for metric, 'i' for imperial. Derived from Tree Table.
2. derived as either (1) the cumulative sum of sectionLength if heightOfMeasurement not specified or (2) heightOfMeasurement if specified

Ring Table

Field Name	Data Type	Required	Description	Units	Notes
sourceID*	string	yes	ID of the parent source (link to Source Table)		
siteID*	string	yes	ID of the parent site (link to Site Table)		
treeID*	string	yes	ID of the parent tree (link to Tree Table)		
sectionID*	string	yes	ID of the parent section (link to Section Table)		
measurementInterval	int		interval between ring width measurements	years	
ring1	double		cumulative cookie diameter to outside of growth ring 1	cm or in	1
ring2	double		cumulative cookie diameter to outside of growth ring 2	cm or in	
...					
ring N	double		cumulative cookie diameter to outside of growth ring N	cm or in	2
error	int		error code for the rings		

Notes:

1. Ring width is 2 times ring radius.
2. Growth rings are numbered from 1 to N where N is currently set to a maximum allowed value of 150. ring1 refers to the outermost ring of the section, ring2 the next outermost and so on.

Branch Table

Field Name	Data Type	Required	Description	Units
sourceID*	string	yes	ID of the parent source (link to Source Table)	
siteID*	string	yes	ID of the parent site (link to Site Table)	
treeID*	string	yes	ID of the parent tree (link to Tree Table)	
sectionID*	string	yes	ID of the parent section (link to Section Table)	
branchID*	string	yes	ID of the branch	
branchOrder	int		branch order, 1 being first order, 2 second, etc...	
diameterOutsideBark	double		diameter outside bark at base of branch	cm or in
diameterInsideBark	double		diameter inside bark at base of branch	cm or in
doubleBarkThickness	double		double bark thickness at base of branch	mm or in

Piece Table

Field Name	Data Type	Required	Description	Units
sourceID*	string	yes	ID of the parent source (link to Source Table)	
siteID*	string	yes	ID of the parent site (link to Site Table)	
treeID*	string	yes	ID of the parent tree (link to Tree Table)	
sectionID*	string	yes	ID of the parent section (link to Section Table)	
branchID*	string	yes	ID of the parent branch (link to Branch Table)	
pieceID*	string	yes	ID of the branch piece	
pieceLength	double		length of branch	m or ft
diameterOutsideBark	double		diameter outside bark at top of piece	cm or in
diameterInsideBark	double		diameter inside bark at top of piece	cm or in
doubleBarkThickness	double		double bark thickness at top of piece	mm or in

Appendix II:

Codes Used in the Stem Data Management System

Country (field: country)

CA	Canada	US	United States

Province (field: provinceState)

AB	Alberta
BC	British Columbia
MB	Manitoba
NB	New Brunswick
NL	Newfoundland and Labrador
NS	Nova Scotia
NT	Northwest Territories
NU	Nunavut
ON	Ontario
PE	Prince Edward Island
QC	Quebec
SK	Saskatchewan
YT	Yukon

State (field: provinceState)

IN	Indiana
MI	Michigan
MN	Minnesota
MO	Missouri
NH	New Hampshire
PA	Pennsylvania
VT	Vermont
WV	West Virginia
WI	Wisconsin

Units of Measure (fields: units, dbhHeightUnits)

m	metric
i	imperial

Table 1. *Data set summary statistics.*

Source	Species	Dbh outside bark (cm) mean (range)	N	Height (m) mean (range)	N	Age mean (range)	N
Beckwith	Aw	16.4 (4-52)	91	15.7 (6-24)	89	47 (24-141)	90
Beckwith	Bb	3.7 (3-4)	2	6.6 (6-7)	2	29 (28-30)	2
Beckwith	Bd	17.5 (3-63)	33	15.1 (6-31)	33	42 (20-100)	33
Beckwith	Be	17.4 (5-46)	25	16 (7-24)	25	71 (36-210)	25
Beckwith	Bn	15.7 (15-17)	2	13.6 (13-14)	2	28 (28-28)	2
Beckwith	Bw	17.8 (7-29)	17	19.7 (13-25)	17	45 (24-54)	17
Beckwith	By	11.2 (6-16)	10	13.8 (10-17)	10	55 (28-77)	10
Beckwith	Cb	16.8 (5-34)	52	17.2 (9-25)	52	46 (24-68)	52
Beckwith	Cs	11.9 (4-22)	15	13.4 (7-18)	15	32 (18-39)	15
Beckwith	Er	8.1 (2-14)	6	10.3 (6-14)	6	32 (25-41)	6
Beckwith	Ew	13.8 (6-20)	3	13.1 (8-17)	3	29 (27-34)	3
Beckwith	Hb	8.9 (5-14)	4	11.4 (9-14)	4	32 (28-34)	4
Beckwith	Hi	17.1	1	22.6	1	64	1
Beckwith	Iw	4.9 (3-7)	6	8.7 (4-12)	6	30 (25-35)	6
Beckwith	Le	23.6 (13-41)	35	21 (13-28)	35	43 (36-48)	35
Beckwith	Mh	14.7 (2-54)	520	15.9 (2-29)	520	52 (14-100)	521
Beckwith	Mr	12.1 (5-21)	8	14.7 (10-23)	8	44 (27-64)	8
Beckwith	Or	23.2 (9-36)	28	20.8 (12-26)	29	60 (25-82)	29
Beckwith	Po	17.2 (13-22)	5	19.1 (15-22)	5	48 (48-49)	5
Beckwith	Pr	19.1 (7-33)	433	17.5 (5-43)	433	40 (27-52)	433
Beckwith	Ps	14.7	1	17.1	1	46	1
Beckwith	Pw	21.4 (11-36)	26	19.2 (14-24)	26	51 (48-55)	26
Total N			**1323**		**1322**		**1324**

Table 1. Data set summary statistics. (continued)

Source	Species	Dbh outside bark (cm) mean (range)	N	Height (m) mean (range)	N	Age mean (range)	N
Boise	Pj	23 (12-37)	98	16.7 (10-22)	98	93 (39-149)	98
Total N			**98**		**98**		**98**
Hansen	Ab	26.7 (11-46)	35	19.7 (11-28)	34		0
Hansen	Ag	38 (17-51)	9	22.9 (13-29)	9		0
Hansen	Aw	36.9 (13-64)	79	23.1 (7-34)	73		0
Hansen	Bd	34.7 (14-89)	195	22.4 (14-35)	190		0
Hansen	Be	35.5 (11-91)	41	21.5 (15-28)	41		0
Hansen	Bf	21.9 (10-46)	464	15.8 (8-24)	433		0
Hansen	Bn	38.1 (28-50)	5	22.2 (19-25)	4		0
Hansen	Bw	21.9 (7-57)	590	18.6 (8-26)	568		0
Hansen	By	35.2 (10-71)	91	19.2 (11-27)	84		0
Hansen	Cb	32.4 (14-63)	33	22.1 (10-28)	30		0
Hansen	Cc	14.2	1	13.3	1		0
Hansen	Ci	69.1 (57-98)	7	23.2 (20-30)	7		0
Hansen	Cr	19.2 (9-38)	284	9.7 (6-15)	283		0
Hansen	Cw	25.1 (9-42)	37	13.3 (8-20)	37		0
Hansen	Ea	13.2	1	10.3	1		0
Hansen	Er	46.2 (15-72)	13	22.2 (15-28)	11		0
Hansen	Eu	50.2 (46-55)	2	23.3 (23-23)	1		0
Hansen	Ew	33.5 (10-68)	182	20.9 (6-27)	155		0
Hansen	Hb	39.1 (25-49)	5	24.4 (21-29)	5		0
Hansen	Hbl	15.6 (13-18)	2	10 (9-11)	2		0
Hansen	He	38.6 (15-74)	73	17.6 (9-28)	71		0
Hansen	Hk	40.9 (18-57)	3	21.6 (10-28)	3		0
Hansen	Hm	41 (19-62)	11	22.5 (12-28)	11		0
Hansen	Hp	33.6 (15-46)	11	23.1 (12-31)	11		0
Hansen	Hs	41.7 (15-54)	29	22.5 (12-29)	28		0
Hansen	Iw	15.2 (6-27)	19	13.6 (10-17)	18		0
Hansen	La	21.6 (14-27)	12	16.4 (13-19)	12		0
Hansen	Ls	36.8 (23-51)	3	26.1 (24-28)	3		0
Hansen	Mh	31 (5-95)	668	20.9 (7-30)	651		0
Hansen	Mo	22.4	1	15.5	1		0
Hansen	Mr	22.9 (4-81)	492	18.3 (7-32)	480		0
Hansen	Ms	46.4 (24-75)	53	24.4 (18-30)	49		0
Hansen	Ob	36.2 (11-75)	59	19.2 (8-29)	58		0
Hansen	Obl	39.2 (13-112)	169	20.1 (10-30)	164		0
Hansen	Obu	27.2	1	13.8	1		0
Hansen	Och	36.3	1	15.9	1		0
Hansen	Ol	33.9 (21-43)	9	19.7 (12-24)	9		0
Hansen	Onp	23.7 (10-57)	127	12.9 (5-27)	121		0
Hansen	Oo	37.7 (13-57)	12	16.8 (10-23)	12		0
Hansen	Op	50.4 (32-61)	7	27.9 (24-34)	7		0
Hansen	Or	35.5 (6-182)	571	20 (7-33)	517		0
Hansen	Osh	38.4	1	18.1	1		0
Hansen	Osr	56.5 (54-59)	2	21.1 (19-23)	2		0
Hansen	Osw	36.8 (19-46)	3	18.9 (10-24)	3		0
Hansen	Ow	35.5 (10-85)	242	18.8 (8-29)	238		0
Hansen	Pb	23.6 (13-43)	73	20.5 (11-28)	72		0
Hansen	Pd	54.9 (23-96)	79	28.5 (18-39)	79		0
Hansen	Pi	32 (14-46)	130	19.5 (12-25)	130		0
Hansen	Pj	21.1 (7-49)	1198	16 (5-28)	1043		0
Hansen	Pl	26.8 (8-51)	397	21.8 (11-31)	380		0
Hansen	Pm	16.5	1	9.7	1		0
Hansen	Pr	21 (7-58)	1066	15.2 (7-27)	996		0
Hansen	Ps	12.5 (6-18)	20	8.7 (2-12)	20		0
Hansen	Pt	26.6 (7-52)	1400	21.1 (9-29)	1313		0

Table 1. Data set summary statistics. (continued)

Source	Species	Dbh outside bark (cm) mean (range)	N	Height (m) mean (range)	N	Age mean (range)	N
Hansen	Pw	35.5 (7-84)	189	19.2 (7-30)	155		0
Hansen	Sb	18.4 (9-45)	228	15.1 (8-25)	219		0
Hansen	Sn	34.8	1	17.3	1		0
Hansen	Sw	29.1 (12-66)	176	16.8 (8-32)	172		0
Hansen	Sy	52.9 (37-94)	25	26.4 (21-33)	24		0
Hansen	Td	43.7	1	25.9	1		0
Hansen	Tp	53.5 (39-73)	12	30.8 (28-34)	12		0
Hansen	Wb	50.5 (45-55)	4	26.9 (25-28)	4		0
Total N			**9655**		**9063**		**0**
Honer	Af	26.7 (19-41)	13	20.5 (15-27)	13	–	0
Honer	Be	12.7 (6-23)	13	16.1 (10-21)	13	60 (52-72)	13
Honer	Bf	20.4 (4-48)	535	15.5 (4-30)	535	68 (15-148)	296
Honer	Bw	19.8 (6-49)	372	14.5 (9-27)	372	79 (23-189)	369
Honer	Bww	16.3 (7-28)	15	18.3 (11-23)	15	60 (47-81)	6
Honer	By	26 (9-77)	310	14.9 (9-27)	310	92 (36-296)	305
Honer	Cw	23.4 (18-30)	67	13.1 (11-16)	67	109 (90-126)	9
Honer	Cwr	40 (7-125)	68	24.1 (6-49)	68	98 (43-150)	23
Honer	Cx	15.5 (5-43)	64	10.4 (5-20)	64	–	0
Honer	Df	54.8 (5-187)	203	33.9 (6-74)	203	142 (20-571)	195
Honer	Hw	9.7	1	10.5	1	49 (49-49)	1
Honer	Lw	18.1 (9-30)	87	19.5 (10-27)	87	59 (27-75)	85
Honer	Mh	40.6	1	22.3	1	185 (185-185)	1
Honer	Mr	18.3	1	20.1	1	55 (55-55)	1
Honer	Mx	30.9 (7-56)	22	19.3 (11-26)	22	127 (52-223)	18
Honer	Pb	11.2 (8-43)	124	11.4 (8-21)	124	31 (0-47)	123
Honer	Pg	21.7 (6-47)	728	18.7 (8-31)	728	87 (0-228)	440
Honer	Pj	17.2 (4-165)	1658	14.8 (5-29)	1658	58 (15-127)	977
Honer	Pl	22.3 (5-37)	65	19.5 (9-26)	65	50 (19-68)	63
Honer	Po	24.1 (9-48)	622	20.9 (7-30)	622	56 (10-103)	417
Honer	Pr	30.5 (5-66)	1044	20.2 (5-36)	1044	73 (21-300)	751
Honer	Pt	17 (6-33)	124	17.8 (10-27)	124	36 (0-62)	116
Honer	Pw	29.8 (4-83)	1192	20.1 (6-37)	1192	79 (17-239)	910
Honer	Pww	20.6 (8-42)	10	22.5 (10-40)	10	65 (50-76)	8
Honer	Px	18	1	17.2	1	–	0
Honer	Sb	20 (5-53)	746	15.6 (4-25)	746	91 (30-223)	626
Honer	Se	29.4 (5-69)	205	24.1 (6-47)	205	34 (25-47)	27
Honer	Si	110.5 (74-148)	10	57.7 (49-63)	10	144 (127-160)	10
Honer	Sr	20.1 (4-43)	227	13.5 (6-26)	227	105 (22-290)	188
Honer	Sw	25.9 (3-175)	864	18.3 (5-36)	864	64 (0-226)	543
Total N			**9392**		**9392**		**6521**
KC	Pj	22.4 (11-33)	120	21.6 (15-26)	125	94 (59-143)	125
Total N			**120**		**125**		**125**
MacFarlane	Aw	39 (15-78)	58	25.6 (11-35)	59		0
MacFarlane	Bd	36 (15-78)	63	22.6 (12-29)	63		0
MacFarlane	Be	29.6 (12-54)	83	19.1 (8-28)	83		0
MacFarlane	Bw	25.4 (12-57)	56	20.7 (7-25)	56		0
MacFarlane	By	32.5 (17-64)	48	19.7 (11-25)	48		0
MacFarlane	Cb	30.3 (15-44)	24	22.8 (16-27)	24		0
MacFarlane	Mh	29.8 (12-59)	121	22 (13-28)	121		0
MacFarlane	Mr	31.1 (12-67)	120	21.8 (15-32)	120		0
MacFarlane	Onp	44.7	1	22.9	1		0
MacFarlane	Or	32.8 (13-57)	110	24.3 (15-32)	110		0

Source	Species	Dbh outside bark (cm) mean (range)	N	Height (m) mean (range)	N	Age mean (range)	N
MacFarlane	Ow	36.9 (21-59)	38	23.2 (19-26)	38		0
MacFarlane	Po	29.1 (15-45)	60	22.1 (15-32)	60		0
MacFarlane	Pw	50.6 (15-102)	57	22.6 (12-34)	57		0
Total N			**839**	**0**	**840**	**0**	**0**
NER	Pj	16.6 (2-34)	174	15.3 (3-25)	174	80 (20-138)	174
Total N			**174**		**174**		**174**
VanDyck	Ab	35 (19-58)	7	28.5 (25-32)	6		0
VanDyck	Ag	32	1	26.2	1		0
VanDyck	Aw	41.1 (14-64)	15	28.2 (20-32)	13		0
VanDyck	Bc	20.8	1	19.8	1		0
VanDyck	Bd	37.7 (17-59)	25	27.2 (18-33)	17		0
VanDyck	Be	34.1 (17-75)	25	23 (12-32)	16		0
VanDyck	Bf	22.4 (16-34)	27	17.1 (13-21)	20		0
VanDyck	Bw	26.9 (13-42)	63	20.8 (15-24)	37		0
VanDyck	By	32.4 (14-47)	27	20.1 (16-24)	17		0
VanDyck	Cb	44.8 (22-94)	37	29 (17-34)	37		0
VanDyck	Cp	20.3	1	17.6	1		0
VanDyck	Ct	36.6 (29-44)	2	22.6 (20-25)	2		0
VanDyck	Cw	19.4 (14-31)	27	14.2 (11-18)	27		0
VanDyck	Er	31.2 (31-31)	1	23.6 (24-24)	1		0
VanDyck	Gt	31.8	1	27.7	1		0
VanDyck	Hb	33.4 (29-36)	3	27.1 (27-28)	3		0
VanDyck	He	27.6 (22-43)	4	24.2 (22-28)	3		0
VanDyck	Hm	39.3 (26-48)	3	28.7 (27-30)	3		0
VanDyck	Hp	30.8 (29-36)	5	25.5 (16-29)	5		0
VanDyck	Hs	38 (27-48)	3	29.5 (25-32)	3		0
VanDyck	Mh	30.1 (13-59)	117	22.3 (13-30)	106		0
VanDyck	Mp	14.5	1	15.2	1		0
VanDyck	Mr	29.9 (11-68)	63	23.7 (15-32)	32		0
VanDyck	Obl	36.8 (25-69)	42	22.1 (16-32)	42		0
VanDyck	Oc	41.5 (24-66)	11	27.4 (21-32)	11		0
VanDyck	Ol	37.1 (24-59)	52	23.1 (19-29)	52		0
VanDyck	Oo	30.9 (18-47)	9	18.3 (14-21)	9		0
VanDyck	Or	43.2 (13-71)	51	26.3 (21-31)	38		0
VanDyck	Ow	38.8 (22-65)	40	23.2 (17-30)	40		0
VanDyck	Pb	22.8 (16-31)	10	17.6 (14-21)	8		0
VanDyck	Pi	32 (21-46)	38	20.6 (16-26)	38		0
VanDyck	Pj	21.5 (12-38)	62	17.6 (10-25)	61		0
VanDyck	Pl	24.7 (21-31)	6	27.3 (27-28)	6		0
VanDyck	Pm	26.8 (23-30)	2	21.9 (22-22)	2		0
VanDyck	Pr	27.9 (13-59)	291	20.1 (9-26)	267		0
VanDyck	Pt	29.5 (14-51)	96	23.8 (18-29)	66		0
VanDyck	Pw	34.3 (13-59)	17	21.3 (13-29)	16		0
VanDyck	Sb	20.2 (15-26)	6	17.7 (16-20)	6		0
VanDyck	Sr	16	1	18.1	1		0
VanDyck	Ss	20.1	1	22.3	1		0
VanDyck	Sw	26.8 (16-40)	10	16.9 (13-22)	7		0
VanDyck	Sy	59.9	1	31.8	1		0
VanDyck	Tp	42.7 (22-58)	24	30.2 (19-38)	24		0
Total N			**1229**		**1049**		**0**
Grand Total			**22830**		**22063**		**8242**

Table 2. Species codes.

Code	Common Name	Genus	Species	MNR #	FIA #
Bf	Balsam Fir	Abies	balsamea	20	
Af	Alpine Fir	Abies	lasiocarpa		
Mm	Manitoba Maple	Acer	negundo	117	
Mp	Striped Maple	Acer	pensylvanicum	1001	
Mn	Norway Maple	Acer	platanoides	34	
Mr	Red Maple	Acer	rubrum	32	
Ms	Silver Maple	Acer	saccharinum	33	317
Mh	Sugar Maple	Acer	saccharum	30	
Mb	Black Maple	Acer	saccharum ssp. nigrum	94	
Mx	Acer species	Acer	sp	1111	
Mt	Mountain Maple	Acer	spicatum	1002	
Mf	Freeman's Maple	Acer	x freemanii	177	
Obu	Ohio Buckeye	Aesculus	glabra		331
Hc	Horse Chestnut	Aesculus	hippocastanum	69	
Ax	Alnus species	Alnus	sp	1112	
Pa	Pawpaw	Asimina	triloba	119	
By	Yellow Birch	Betula	alleghaniensis	37	
Bc	Cherry Birch	Betula	lenta	112	
Bw	Paper Birch	Betula	papyrifera	38	
Bww	Western White Birch	Betula	papyrifera var commutata		
Bp	European Weeping Birch	Betula	pendula	120	
Bg	Gray Birch	Betula	populifolia	168	
Bb	American Hornbeam	Carpinus	caroliniana	111	
Hm	Mockernut Hickory	Carya	alba		
Hb	Bitternut Hickory	Carya	cordiformis	123	
Hp	Sweet Pignut Hickory	Carya	glabra	89	
Hl	Big Shellbark Hickory	Carya	laciniosa	93	
Hs	Shagbark Hickory	Carya	ovata	124	
Hbl	Black Hickory	Carya	texana		408
Ci	Pecan	Carya	illinoinensis		
Cd	American Chestnut	Castanea	dentata	171	
Cat	Northern Catalpa	Catalpa	speciosa	77	
Hk	Common Hackberry	Celtis	occidentalis	68	462
Red	Redbud	Cercis	canadensis	125	
Ht	Hawthorn species	Crataegus	sp	128	
Pm	Common Persimmon	Diospyros	virginiana		
Be	American Beech	Fagus	grandifolia	44	
Aw	White Ash	Fraxinus	americana	46	
Ab	Black Ash	Fraxinus	nigra	45	
Ag	Green Ash	Fraxinus	pennsylvanica	47	
Ap	Pumpkin Ash	Fraxinus	profunda	901	
Aq	Blue Ash	Fraxinus	quadrangulata	132	
Gt	Honey Locust	Gleditsia	triacanthos	96	
Kk	Kentucky Coffee-tree	Gymnocladus	dioicus	133	
Haz	American Witch-hazel	Hamamelis	virginiana	82	
Bn	Butternut	Juglans	cinerea	55	601
Wb	Black Walnut	Juglans	nigra	54	602
Cr	Eastern Red Cedar	Juniperus	virginiana	23	68
Le	European Larch	Larix	decidua	26	
La	American Larch	Larix	laricina	25	71
Lj	Japanese Larch	Larix	leptolepis	27	
Lw	Western Larch	Larix	occidentalis		
Ls	Sweetgum	Liquidambar	styraciflua		611
Tp	Tulip Tree	Liriodendron	tulipifera	60	
Ct	Cucumber Tree	Magnolia	acuminata	136	
Mo	Red Mulberry	Morus	rubra	175	682
Gb	Black Gum	Nyssa	sylvatica		137
Iw	Ironwood	Ostrya	virginiana	56	701
Sn	Norway Spruce	Picea	abies	15	91
Sw	White Spruce	Picea	glauca	12	
Sb	Black Spruce	Picea	mariana	13	

Table 2. *Species codes. (continued)*

Code	Common Name	Genus	Species	MNR #	FIA #
Sr	Red Spruce	Picea	rubens	14	
Se	Engleman Spruce	Picea	englemannii		
Si	Sitka Spruce	Picea	sitchensis		
Px	Pinus species	Pinus	sp		
Pj	Jack Pine	Pinus	banksiana	3	
Pn	Black Pine	Pinus	nigra	6	
Pr	Red Pine	Pinus	resinosa	2	
Pp	Pitch Pine	Pinus	rigida	5	
Pw	Eastern White Pine	Pinus	strobus	1	
Ps	Scotch Pine	Pinus	sylvestris	4	130
Pg	Lodgepole Pine	Pinus	contorta		
Pww	Western White Pine	Pinus	monticola		
Pi	Shortleaf Pine	Pinus	echinata		
Sy	Sycamore	Platanus	occidentalis	57	
Po	Populus species	Populus	sp	75	
Pe	White Poplar	Populus	alba	76	
Pb	Balsam Poplar	Populus	balsamifera	73	
Pd	Eastern Cottonwood	Populus	deltoides	71	742
Pl	Large-tooth Aspen	Populus	grandidentata	70	
Pt	Trembling Aspen	Populus	tremuloides	74	
Ph	Hybrid Poplar	Populus	X	97	
Pc	Carolina Poplar	Populus	x canadensis	72	
Cm	Sweet Cherry	Prunus	avium	90	
Cs	Sour Red Cherry	Prunus	cerasus	174	
Cp	Pin Cherry	Prunus	pensylvanica	139	
Cb	Black Cherry	Prunus	serotina	58	
Ch	Prunus species	Prunus	sp	1062	
Cc	Choke Cherry	Prunus	virginiana	1065	763
Df	Douglas Fir	Pseudotsuga	menziesii		
Ow	White Oak	Quercus	alba	40	
Osw	Swamp White Oak	Quercus	bicolor	88	804
Ob	Bur Oak	Quercus	macrocarpa	42	823
Och	Chinquapin/Chinquapin Oak	Quercus	muehlenbergii	91	826
Op	Pin Oak	Quercus	palustris	87	830
Or	Northern Red Oak	Quercus	rubra	41	
Os	Shumard's Oak	Quercus	shumardii	39	
Ox	Quercus species	Quercus	sp	1193	
Obl	Black Oak	Quercus	velutina	86	
Oc	Chestnut Oak	Quercus	prinus		
Ol	Scarlet Oak	Quercus	coccinea		
Oo	Post Oak	Quercus	stellata		
Onp	Northern Pin Oak	Quercus	ellipsoidalis		809
Osh	Shingle Oak	Quercus	imbricaria		817
Osr	Southern Red Oak	Quercus	falcata		812
Lb	Black Locust	Robinia	pseudo-acacia	61	
Wi	Salix species	Salix	sp	1086	
Ss	Sassafras	Sassafras	albidum	78	
Ema	European Mountain-ash	Sorbus	aucuparia	146	
Am	Sorbus species	Sorbus	sp	1091	
Td	Bald Cypress	Taxodium	distichum		221
Cx	Cedar species	Cedar	sp		
Cw	Eastern White Cedar	Thuja	occidentalis	22	
Cwr	Western Red Cedar	Thuja	plicata		
Bd	American Basswood	Tilia	americana	51	
Ll	Little-leaf Linden	Tilia	cordata	150	
Bl	Big-leaf Linden	Tilia	platyphyllos	166	
He	Eastern Hemlock	Tsuga	canadensis	19	
Hw	Western Hemlock	Tsuga	heterophylla		
Ew	American Elm	Ulmus	americana	50	972
Er	Slippery Elm	Ulmus	rubra	169	
Eu	Rock Elm	Ulmus	thomasii	170	977
Ea	Winged Elm	Ulmus	alata		971

Appendix III:

Error Codes for the Section and Tree Tables in the Stem Data Management System

The following values are assigned to the 'error' field of the Section and Tree Tables after validation to indicate the type of error associated with a record, if any. If the tree record has no error but one of its sections does, the tree will be assigned the error code for the section.

Tree Table

0: No error
1: Diameter outside bark less than inside bark
2: Questionable height to diameter ratio
3: Questionable diameter outside bark
4: Questionable total tree height
5: Pulplog height greater than tree height
6: Sawlog height greater than tree height
7: Height to live crown greater than tree height
8: Age height greater than tree height
9: Bark height greater than tree height
99: More than one error (check the 'errorList' field of the Tree table in the Error library for details).

Section Table

0: No error
21: Diameter outside bark less than inside bark
22: Section diameter outside bark greater than that of previous section
23: Section diameter inside bark greater than that of previous section
24: Double bark thickness increases with increasing height
25: Diameter outside bark <= 0 at a section other than last section
26: Section height greater than tree height
27: Ring count greater than that of previous section
99: More than one error (check the 'errorList' field of the Section table in the Error library for details).

Ring Table

0: No error
41: Ring width exceeds that of the preceeding ring in the section
42: Ring width increases with section height

Appendix IV:

SAS Programs Used in the Stem Data Management System

- batch.sas
- constants.sas
- exporterCsv.sas
- extractor.sas
- importer.sas
- macros.sas
- session.sas
- status.sas
- translatorBeckwith.sas
- translatorBoise.sas
- translatorBoise2.sas
- translatorHansen.sas
- translatorHansen2.sas
- translatorHoner.sas
- translatorKC.sas
- translatorKC2.sas
- translatorMacFarlane.sas
- translatorNER.sas
- translatorNER2.sas
- translatorVanDyck.sas
- validator.sas

Appendix V:

Data Sharing Protocols of SDMS Data Set Providers

Using data assembled by SDMS is possible and encouraged, provided that the data sharing policies specified in this document are respected.

SDMS has been developed by the Great Lakes Stem Profile Modelling Project in a partnership among OMNR, DNRs of Michigan, Minnesota and Wisconsin, USDA Forest Service North Central Region, and Michigan State University in Lansing, MI. Each partner owns a CD copy of SDMS V.2.0, which includes a set of computer programs for working with stem analysis data, as well as the entire data set generated by the SDMS project, in a unified Excel format. Each CD also includes a copy of this documentation specifying data sharing rules defined by the respective data owners. SDMS data requests should be directed to the Great Lakes Stem Profile Modelling Project (GSPMP) at the Ontario Forest Research Institute, 1235 Queen Street East, Sault Ste. Marie, Ontario, Canada P6A 2E5. Requests for specific data may also be made directly from the individual owners (identified below).

Canadian Forestry Service - Honer data set. Use of CFS data sets is based on a project-specific data sharing agreement. Acknowledgement of CFS is requested. Contact person: Guy Smith, Natural Resources Canada, Canadian Forest Service, Great Lakes Forestry Centre; phone: (705)541-5595; e-mail gusmith@nrcan.gc.ca

Michigan State University - MacFarlane data set. Send data request to Dr. David W. MacFarlane, Department of Forestry, Michigan State University, 126 Natural Resources Bldg., East Lansing MI 48824; phone: (517)355-2399; e-mail: macfar24@msu.edu. Briefly describe the project, name all potential data users, and indicate the anticipated timeframe for completing the work.

Ontario Ministry of Natural Resources - Beckwith data set, Boise Cascade data set, Kimberly Clark data set, Northeast Region data set. Direct request to Karen Zhou Ontario Terrestrial Assessment Program, 1235 Queen Street East, Sault Ste. Marie, Ontario, Canada P6A 2E5; e-mail Karen.zhou@mnr.gov.on.ca. Specify the end-user of the data set, briefly describe the project, and indicate the anticipated timeframe for completing the work. MNR requires that data not be used for purposes other than those stated in the request. MNR provides data on an "as is" basis and assumes no liability for its use or for providing updates or corrections. The user is expected to acknowledge data contributed by the *Ontario Ministry of Natural Resources* in relevant products or publications. A Data Sharing Agreement signed by authorized representatives of the respective institutions is required.

USDA Forest Service – Van Dyck data set. This data is in the public domain and is available upon request. Request data from Michael Van Dyck, USDA Forest Service, 626 E. Wisconsin Avenue, Suite 700, Milwaukee, WI 53202; e-mail mvandyck@fs.fed.us.

USDA Forest Service – Hansen data set. Records in this data set are public information and available to anyone interested in using them under the terms of the Freedom of Information Act. Send requests to Mark Hansen, USDA, Forest Service, Northern Research Station, 1992 Folwell Ave, St. Paul, MN. 55108; e-mail mhansen01@fs.fed.us. The Forest Service appreciates the opportunity to review any publications that result from the analysis of this data and requests that the USDA Forest Service be acknowledged in any publications.

Appendix VI:

SDMS V. 2.0 - CD

The final data output (in CSV and MS Access formats) and a copy of this research note are stored on CD-ROM. Copies are available on request from the Technology Transfer Unit, OMNR, OFRI, 1235 Queen Street East, Sault Ste. Marie, ON P6A 2E5. Data sharing protocols outlined in Appendix V must be complied with.

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